

【FIG. 1】 A scanning electron photomicrograph of the tip of wustite whisker of 5 nm diameter and length 230nm.

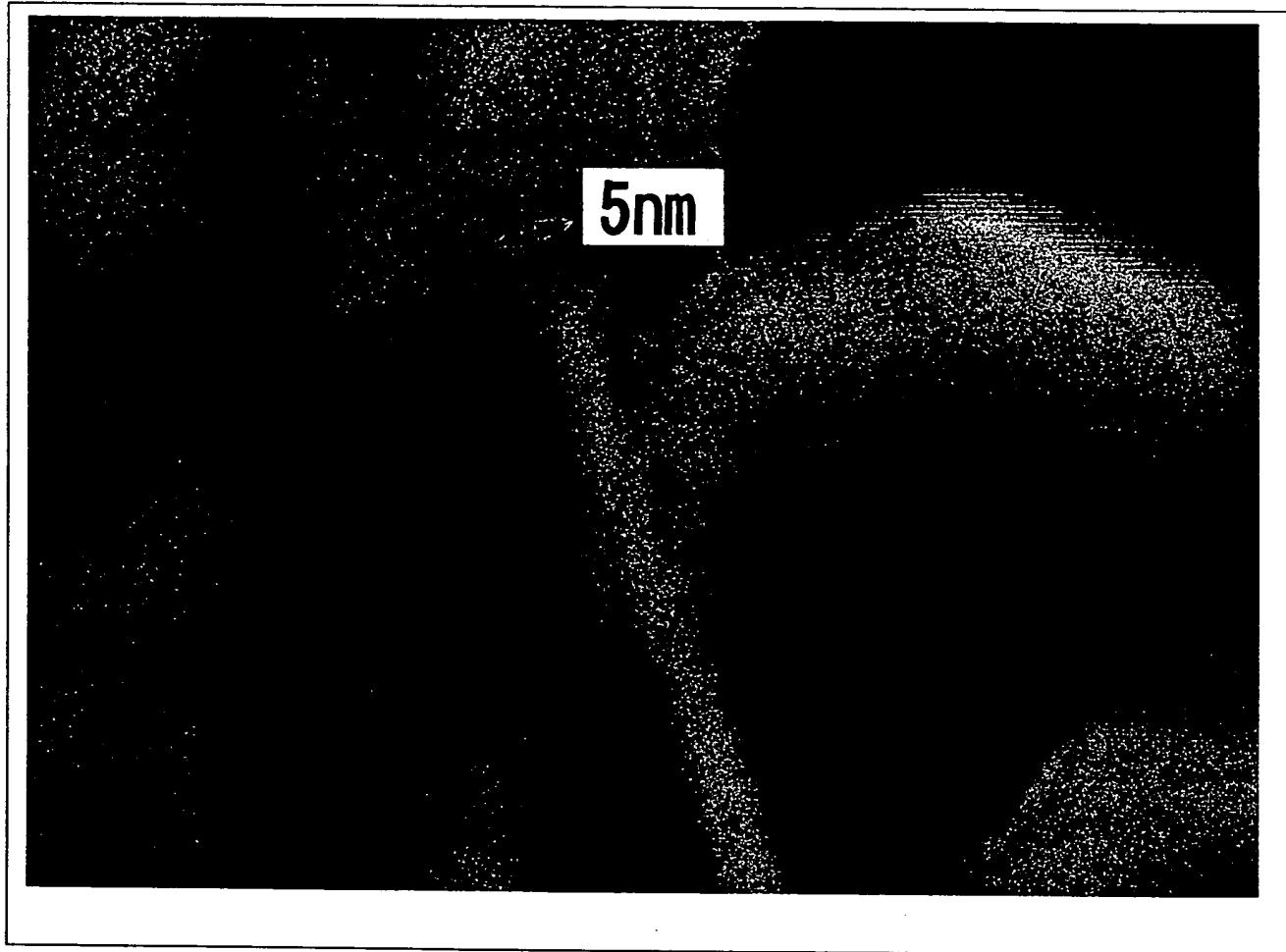


FIG. 1

【FIG. 2】 A scanning electron photomicrograph of whiskers of a magnetite and hematite poly crystalline mixture of diameters between 100nm and 3 μ m. The longest whisker of a diameter 1 μ m and length 1cm. In the background of the microphotograph are aggregates of magnetite polycrystalline on the surface of the iron based substrate plate.

FIG. 2

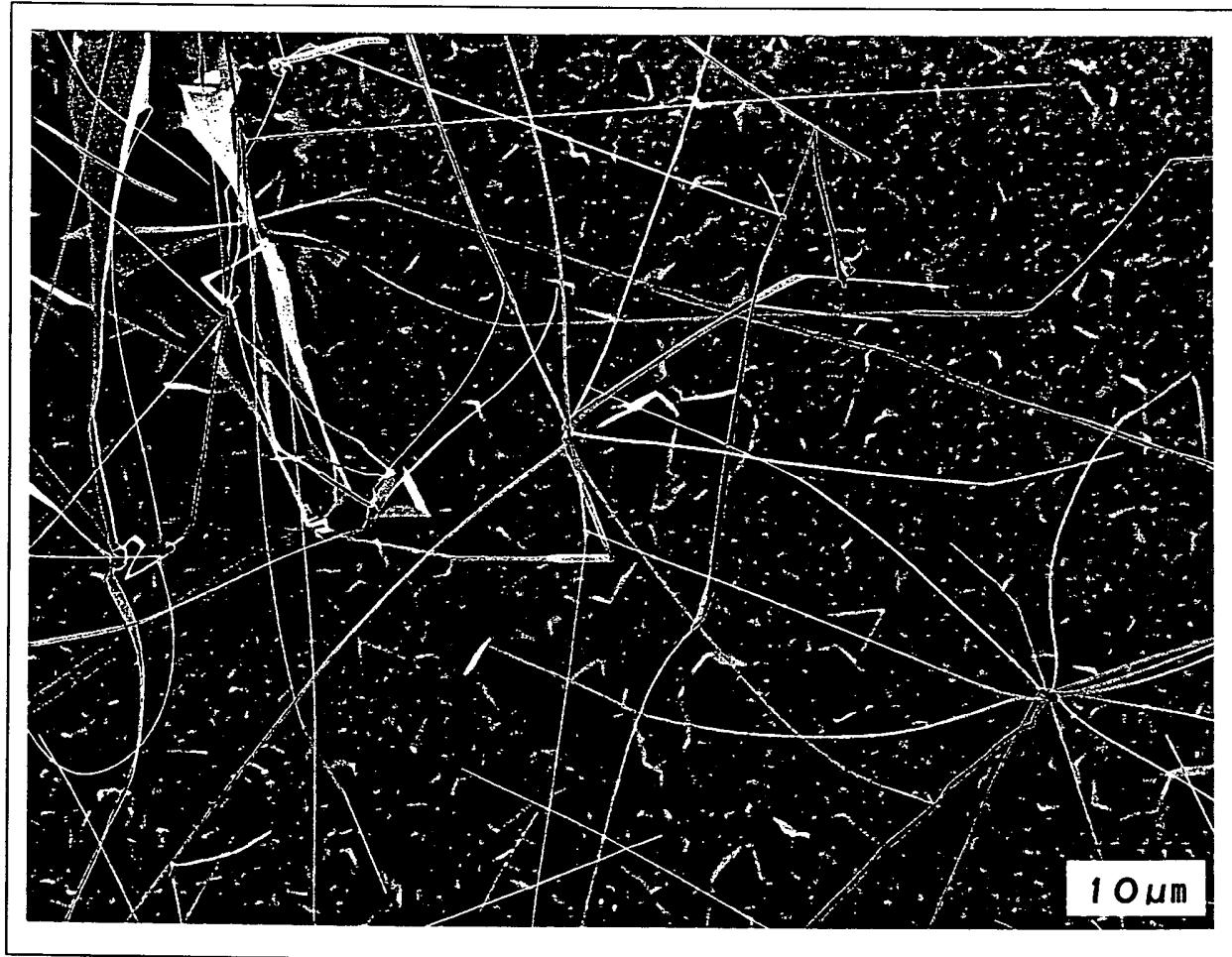


FIG. 2

【FIG. 3】 is a scanning electron photomicrograph of the tip of magnetite whisker of diameter 750nm.

FIG. 3

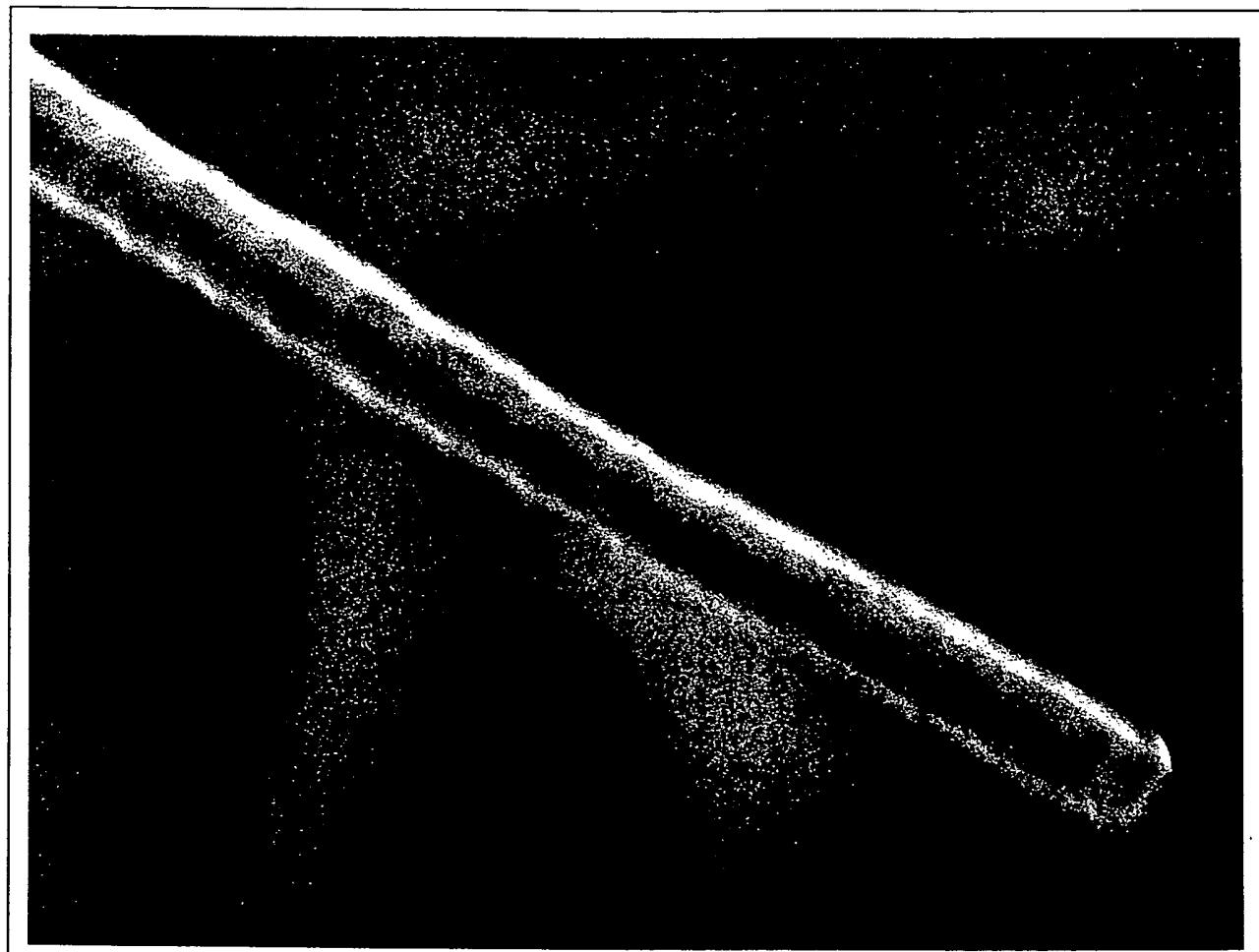
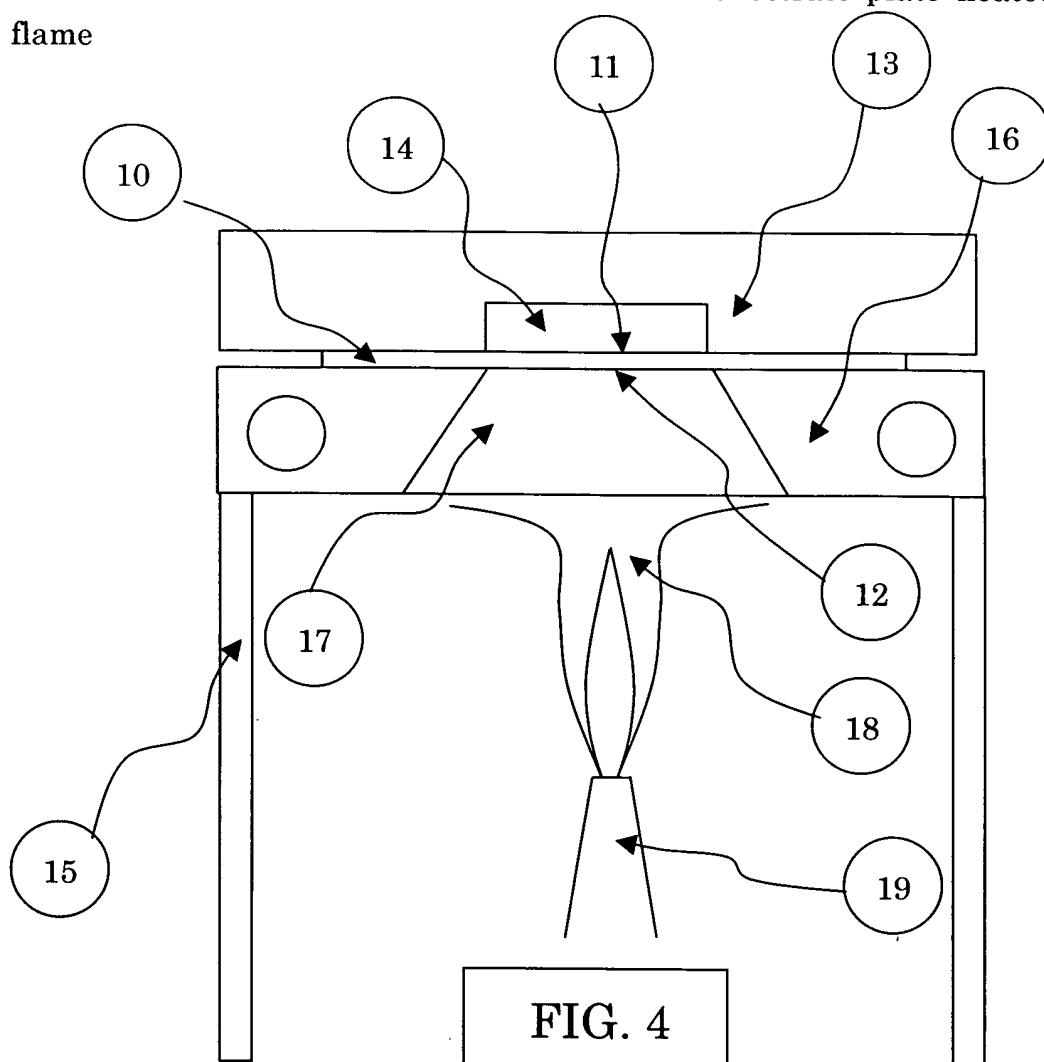


FIG. 3

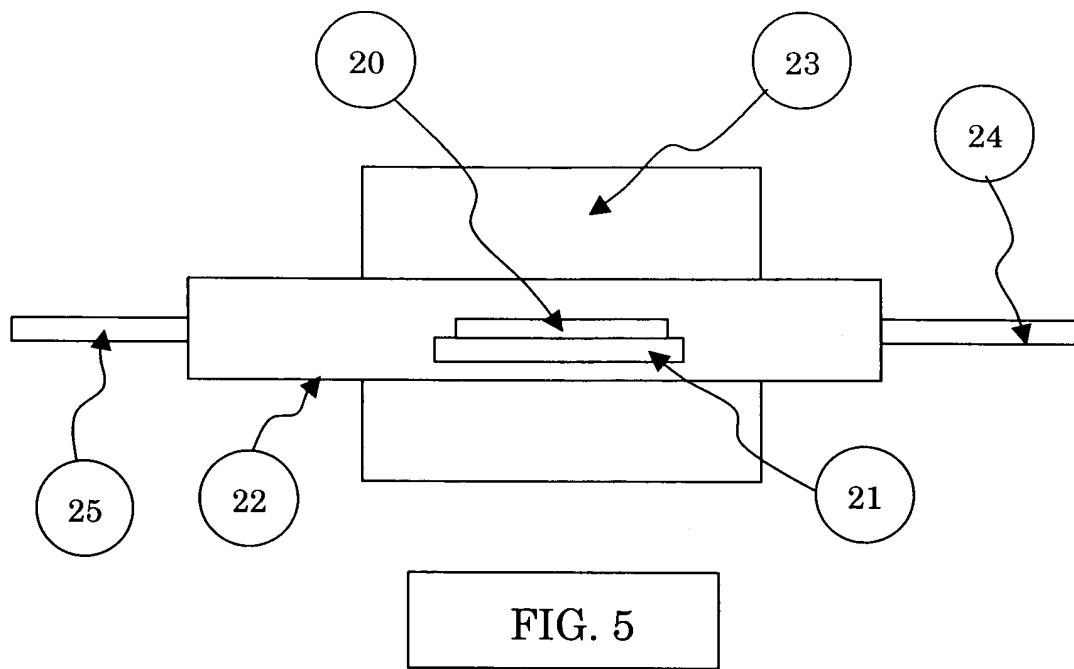
FIG. 4 The cross-sectional view of the apparatus for growing iron oxide whiskers on the surface of iron based metal substrate plate heated by a flame



[explanation of the parts]

- 10..... the substrate plate
- 11..... the whisker growing surface
- 12..... the substrate surface to be heated
- 13..... the cover plate
- 14..... the hole for the whisker growing space
- 15..... the frame
- 16..... the disk to support the substrate plate
- 17..... the tapered hole through which the substrate is heated
- 18..... the flame
- 19..... the burner

FIG. 5 The cross-sectional view of the apparatus for growing iron oxide whiskers on the surface of iron based metal substrate plate placed in the silica glass tube .



[explanation of the parts]

- 20..... the substrate plate
- 21..... the holder for the substrate
- 22..... the quartz tube for the whisker growth
- 23..... the infrared electric furnace
- 24..... the gas inlet
- 25..... the gas outlet

FIG. 6 The graph for vapor pressure v.s. temperature for various oxides.

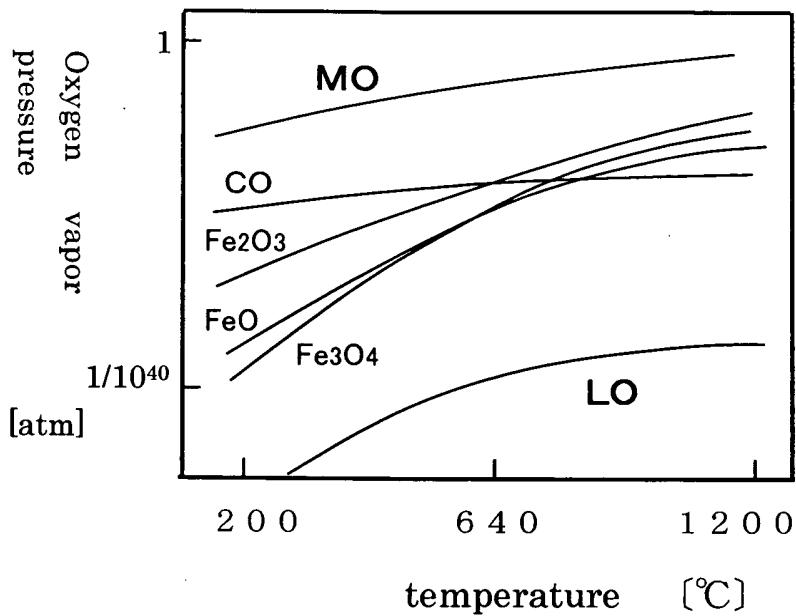


FIG6

FIG. 7 The sketch depicting a potential growing process of a whisker.

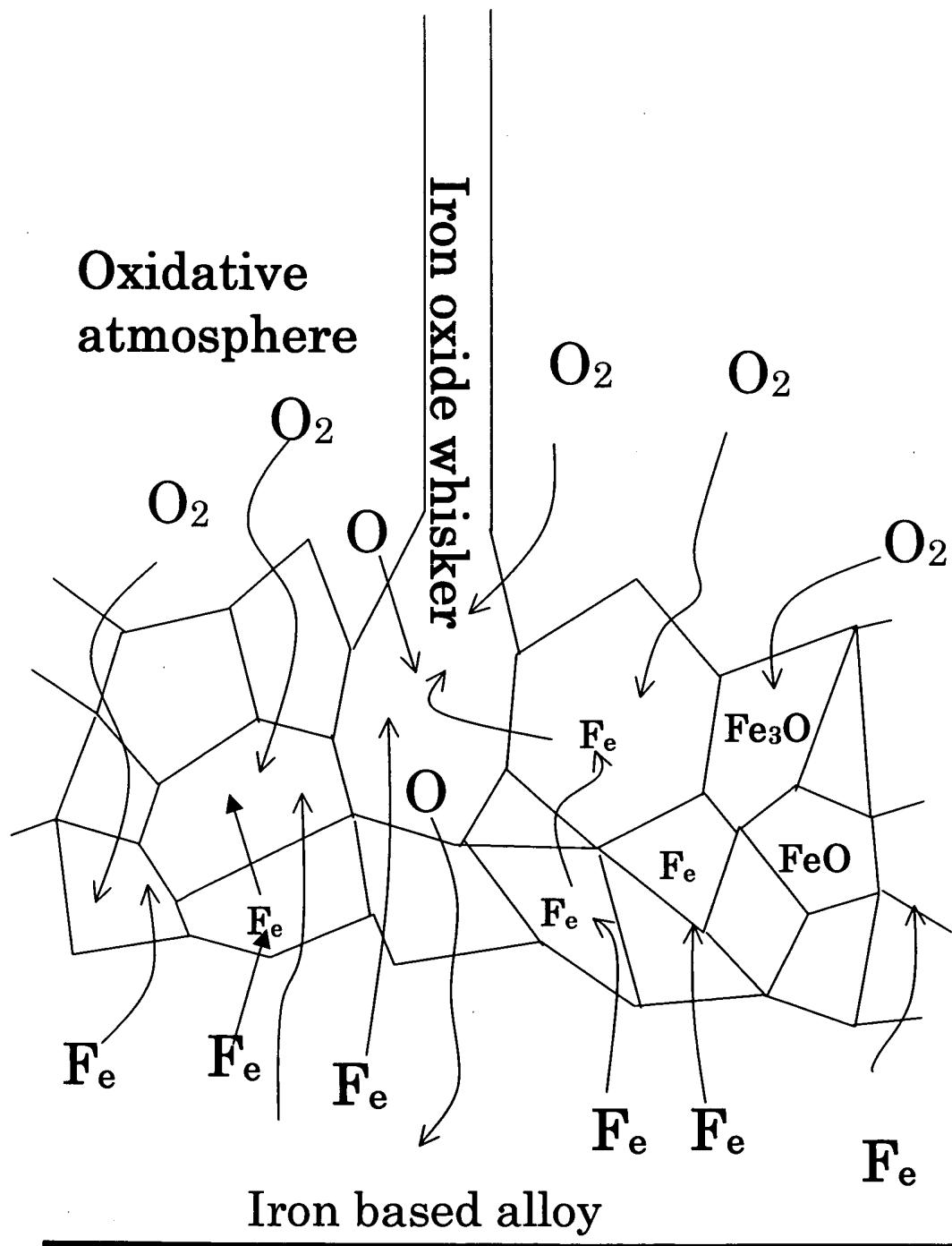


FIG. 7

FIG.8 is a scanning electron photomicrograph of titanium oxide whiskers.

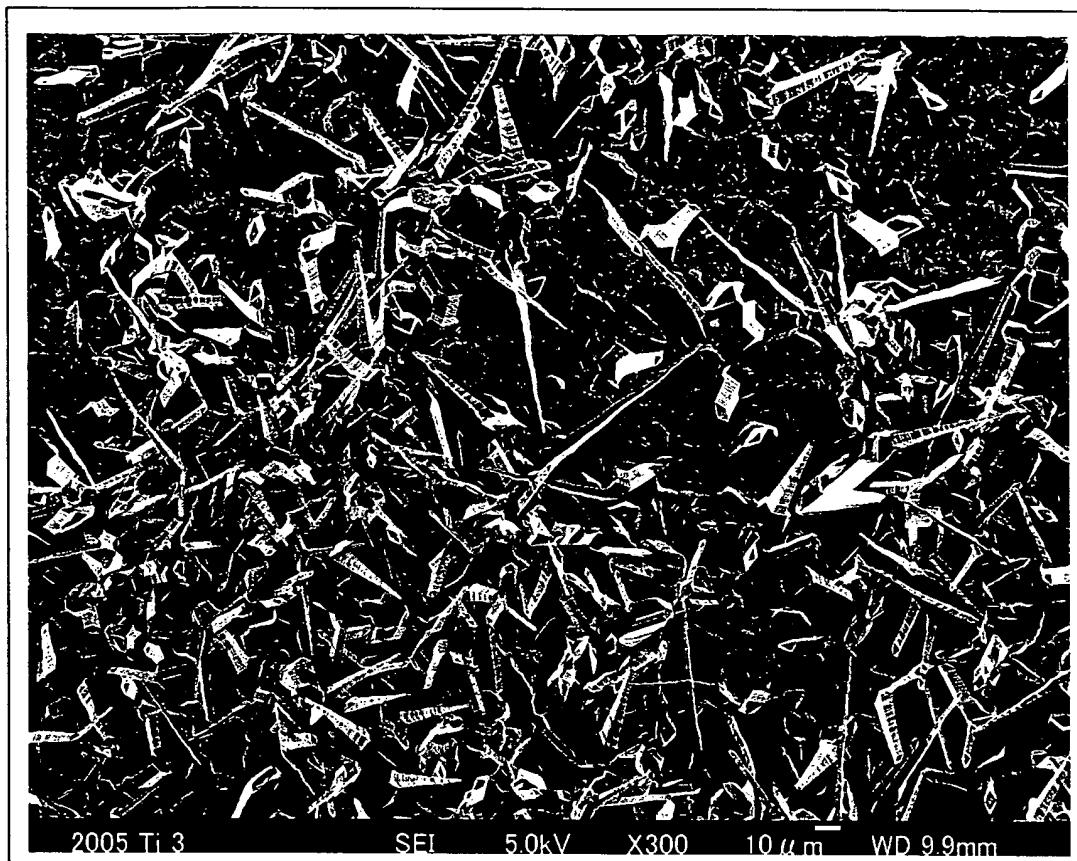


FIG. 8

FIG. 9 is a scanning electron photomicrograph of iron oxide whiskers.

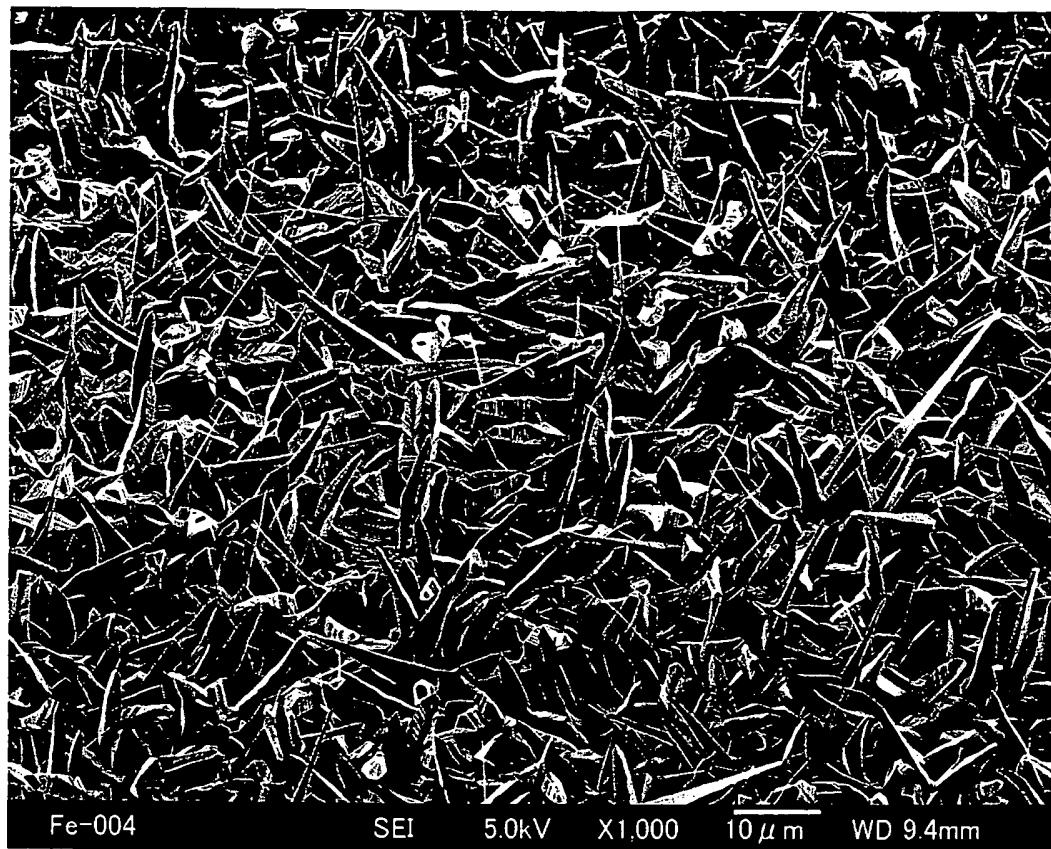


FIG. 9

FIG. 10 The scanning electron photomicrograph of a spiral whisker, A and a zigzag whisker, B.



FIG. 10 (A)



FIG. 10 (B)

FIG. 11 The scanning electron photomicrographs of (A) the hallow magnetite whisker milled by FIB and (B) the magnetite whiskers grown from a magnetite agglomerate.



FIG. 11 (A)

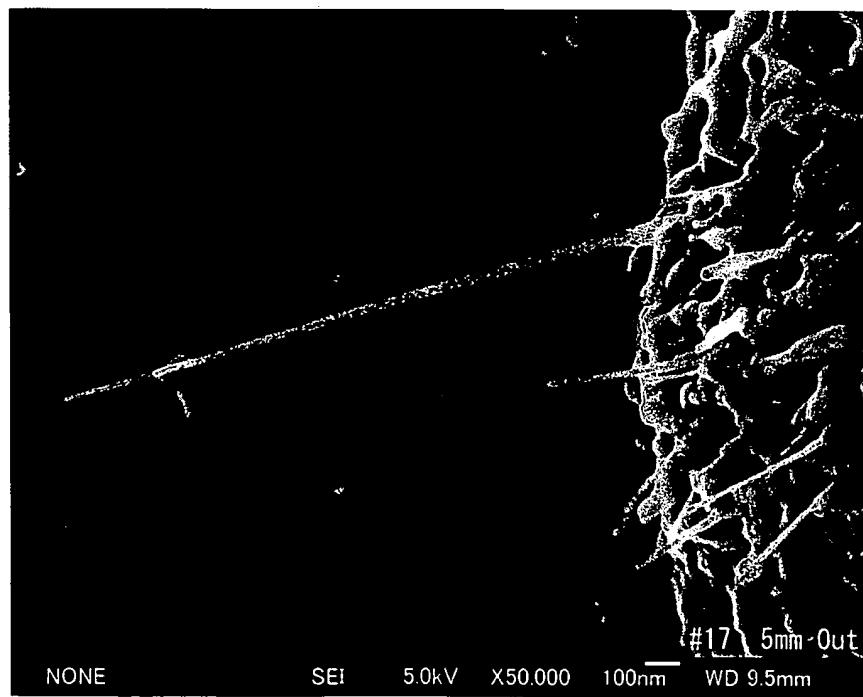


FIG. 11 (B)